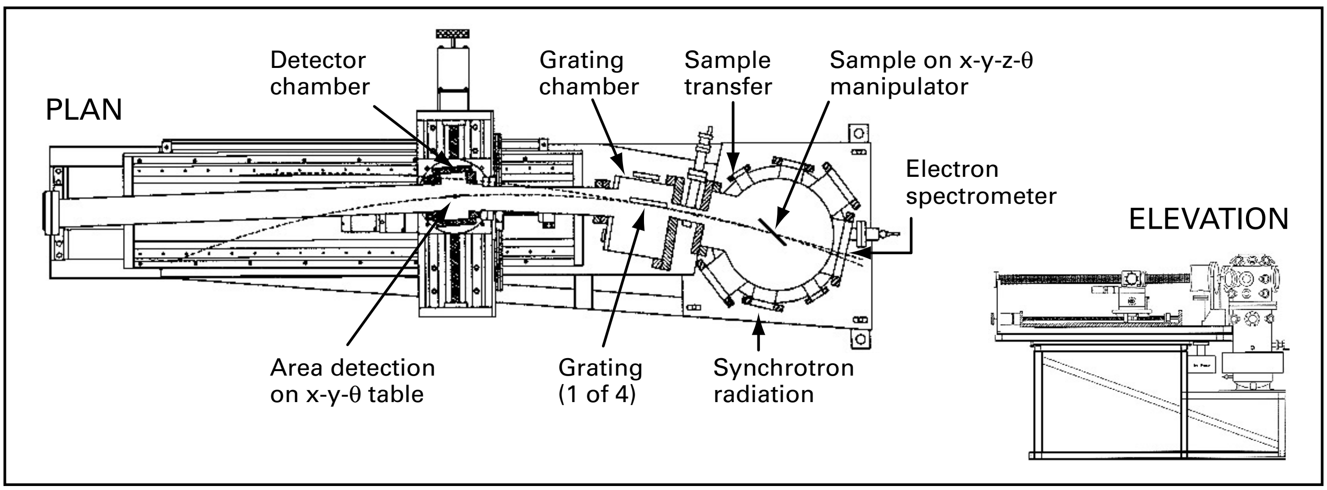
# Soft X-Ray Fluorescence (SXF) Spectrometer • Beamline 8.0.1

Berkeley Lab • University of California

## Endstation Specifications

| Fluorescence Energy Range (eV) | Photon Flux (photons/s) | Spectral Resolution (E/ΔE) | Spot Size (μm) | Samples | Availability |
|---|---|---|---|---|---|
| 40–1000 | ~$10^{10}$–$6\times10^{15}$ (dependent upon photon resolution & energy ) | 400–1900 (dependent upon grating & slit width) | 100 (h) 50–3000 (v) | UHV-Compatible Solids (up to 2 cm in diameter) | NOW |



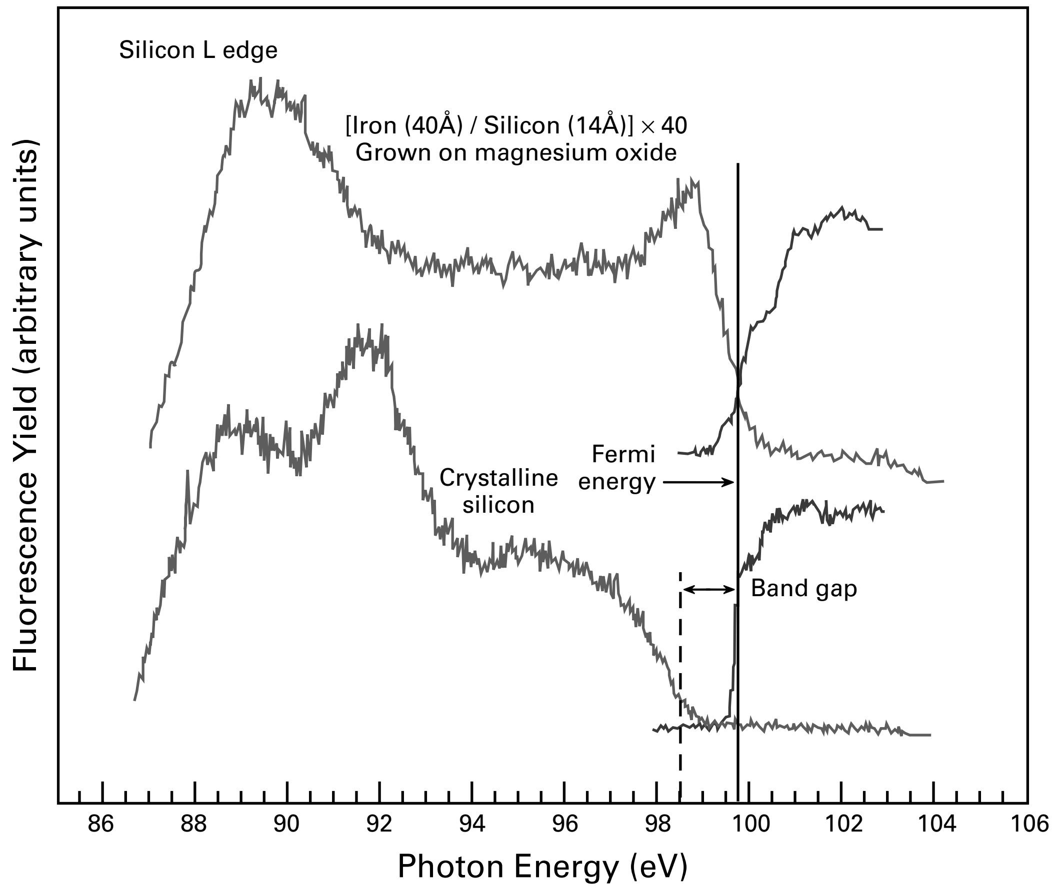

***Plan (left) and elevation*** *(right) schematic views of the SXF spectrometer endstation.*

Beamline 8.0.1 serves two permanently placed, PRT-owned experimental stations for x-ray absorption and photoelectron spectroscopy and imaging of materials and surfaces. The soft x-ray fluorescence (SXF) spectrometer station is owned by Tulane University and the University of Tennessee. It measures soft x-ray emission from solids with a dispersive grating spectrometer. A separate data sheet describes an ellipsoidal mirror electron energy analyzer (EMA) that shares beamtime with the SXF spectrometer by means of a movable platform and a flexible bellows.

The SXF station consists of a Rowland-circle grating emission spectrometer with a photon-counting area detector and a UHV sample chamber. The spectrometer has a fixed (50- or 100-μm) entrance slit and four interchangeable gratings (600 and 1500 lines/mm with radii of 5 and 10 m) to cover the photon energy range from 40 to 1000 eV. A multichannel-plate area detector is mounted on a precision x-y-θ table for scanning along either of the Rowland circles formed by the entrance slit, grating, and detector. In the desired energy range, refocusing the x-ray fluorescence onto the detector enables the entire emission spectrum to be obtained without scanning the detector.

Solid samples up to 2 cm in diameter are mounted in a UHV chamber with an x-y-z-θ sample manipulator and an electron gun for off-line electron excitation. There is also a UHV storage chamber with a load-lock for quick in-vacuum sample exchange.

Typical experiments performed in the station are based on soft x-ray emission, including fluorescence spectroscopy and fluorescence-yield x-ray absorption spectroscopy (XAS). Since x-ray emission is a photon-in/photon-out process, experiments are able to probe to considerable depth below the surface, up to a micron or so, thereby making structures such as buried interfaces accessible. Excitation of core levels provides elemental selectivity and dipole selection rules provide angular momentum selectivity in conduction and valence bands of solid, layered, and thin-film samples. ■




***Fluorscence emission and fluorescence-yield absorption spectra,*** *taken from crystalline silicon (lower spectra) and from an iron silicide layer in a magnetic multilayer material (upper spectra), demonstrate the metallic nature of the iron silicide. Whereas crystalline silicon shows a band gap between occupied and unoccupied states, indicating that it is a semiconductor, the spectra for the iron silicide layer overlap with no band gap, showing that the iron silicide is a metal. Spectra for occupied states were measured using soft-x-ray fluorescence spectroscopy (SXF). Spectra for unoccupied states were measured using fluorescence-yield near-edge x-ray absorption spectroscopy (NEXAFS). Data courtesy of J.A. Carlisle, A. Chaiken, and L.J. Terminello (Lawrence Livermore National Laboratory); J.J. Jia and T.A. Callcott (University of Tennessee); D.L. Ederer (Tulane University); R.C.C. Perera (ALS); and F.J. Himpsel (IBM Research Division).*

To obtain a proposal form, go to www-als.lbl.gov/als/quickguide/independinvest.html.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